## CLAIMS:

**1.** A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of at least one parameter selected from a spin-orbit coupling constant, density of the spin carrying current carriers, and a mobility of the gas, the device having one of the following configurations:

(i) said structure is configured to provide the two-dimensional gas configuration with a desired orientation between an input flux of the spin carrying current carriers and said at least one region of inhomogeneity, which has the varying spin-orbit coupling constant and/or has the varying density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, the device being thereby operable to perform spin manipulations of the input flux to provide at least one of the following types of deviation of said spin carrying current carriers: spin dependent refraction, spin dependent reflection and spin dependent diffraction on desired deviation angles of a direction of motion of the spin carrying current carriers being incident on said at least one region of inhomogeneity; and

(ii) said structure is configured to create the region of inhomogeneity in the form of a lateral interface between first and second regions differing from each other at least in the gas mobility such that the first region is diffusive and the second region is ballistic, the device being thereby operable for emitting the current carriers from the diffusive region into the ballistic region with a wide angular range of directions of propagation of the current carriers in the ballistic region, thereby enabling directing the current carriers to one or more desired range of angles of propagation in the ballistic region.

**2.** The device of claim 1(i), wherein said desired orientation is such that the input flux of the spin carrying current carriers contains the carriers that impinge onto said at least one region of inhomogeneity at a certain range of non-zero angles of incidence.

**3.** The device of claim 1 wherein said structure is configured such that the inhomogeneous two-dimensional gas is confined by at least one potential well.

**4.** The device of claim 3 wherein the potential well is created in a semiconductor structure.

**5.** The device of claim 4 wherein said structure is a semiconductor heterostructure.

**6.** The device of claim 1(i) wherein said structure is configured such that the inhomogeneous two-dimensional gas is confined by at least one nonuniform potential well.

**7.** The device of claim 6 wherein at least one portion of said at least one nonuniform potential well is an asymmetrical potential well.

**8.** The device of claim 6 wherein at least one part of the structure is fabricated from a uniaxial crystal compound with no inversion symmetry.

**9.** The device of claim 6 wherein the nonuniform potential well is created in a semiconductor structure.

**10.** The device of claim 9 wherein said structure is a semiconductor heterostructure.

**11.** The device of claim 10 wherein the semiconductor heterostructure is fabricated from compounds selected from group III – group V, and group II – group VI compounds.

**12.** The device of claim 11 wherein the semiconductor heterostructure is selected from $In_xGa_{1-x}As/In_yAl_{1-y}As$, $In_xGa_{1-x}As/InP$, InAs/AlSb, $In_xAl_{1-x}As/In_yGa_{1-y}As/ In_zAl_{1-z}As$, CdTe/HgTe/CdTe and $Hg_xCd_{1-x}Te$.

**13.** The device of claim 12 wherein x, y and z are in the range of about 0.1 to 1.

**14.** The device of claim 1(ii) wherein said structure is a semiconductor heterostructure fabricated from compounds selected from Si, Ge, group IV – group IV, group III – group V, and group II – group VI compounds.

**15.** The device of claim 1(ii), wherein the ballistic region differs from the diffusive region in the spin-orbit coupling constant, or differs in the density of the

spin-carrying current carriers provided the spin-orbit coupling constant is of non-zero value in at least one of these regions.

**16.** The device of claim 15 wherein said structure is configured such that the inhomogeneous two-dimensional gas is confined by at least one nonuniform potential well.

**17.** The device of claim 16 wherein at least one portion of said at least one nonuniform potential well is an asymmetrical potential well.

**18.** The device of claim 16 wherein at least one part of said structure is fabricated from a uniaxial crystal compound with no inversion symmetry.

**19.** The device of claim 16 wherein said structure is a semiconductor heterostructure.

**20.** The device of claim 19 wherein the semiconductor heterostructure is fabricated from compounds selected from group III – group V, and group II – group VI compounds.

**21.** The device of claim 20 wherein the semiconductor heterostructure is selected from $In_xGa_{1-x}As/In_yAl_{1-y}As$, $In_xGa_{1-x}As/InP$, InAs/AlSb, $In_xAl_{1-x}As/In_yGa_{1-y}As/ In_zAl_{1-z}As$, CdTe/HgTe/CdTe and $Hg_xCd_{1-x}Te$.

**22.** The device of claim 21 wherein x, y and z are in the range of about 0.1 to 1.

**23.** The device of claim 1 comprising at least one gate configured for applying a bias voltage thereto, said bias voltage being sufficient to change said at least one parameter in a region of the two-dimensional gas near said at least one gate to thereby create the region of inhomogeneity.

**24.** The device of claim 1(i) wherein the varying of the spin-orbit coupling constant of the gas within the region of inhomogeneity of the gas measured in units of Fermi velocity is larger than about 0.001.

**25.** The device of claim 15 wherein the varying of the spin-orbit coupling constant of the gas within the region of inhomogeneity of the gas measured in units of Fermi velocity is larger than about 0.001.

**26.** The device of claim 1 wherein the current carriers are selected from electrons and holes.

**27.** The device of claim 1 comprising at least one injector terminal and at least one collector terminal distant from each other, each terminal being defined by a space between two nearest barriers arranged in said structure, the terminals being arranged for allowing the carriers passage from the injector terminal to the collector terminal.

**28.** The device of claim 1(i) comprising at least one injector terminal and at least one collector terminal distant from each other, each terminal being defined by a space between two nearest barriers arranged in said structure, the terminals being arranged for allowing the carriers passage from the injector terminal to the collector terminal.

**29.** The device of claim 15 comprising at least one injector terminal and at least one collector terminal distant from each other, each terminal being defined by a space between two nearest barriers arranged in said structure, the terminals being arranged for allowing the carriers passage from the injector terminal to the collector terminal.

**30.** The device of claim 28 wherein said at least one injector terminal is configured for providing the input flux of unpolarized spin carrying current carriers, and said at least one collector terminal is configured for receiving a current of spin-polarized spin carrying current carriers, the device being therefore configured and operable as a spin filter for producing a current of spin carriers having the predetermined spin polarization.

**31.** The device of claim 28 wherein said at least one injector terminal is configured for providing the input flux of unpolarized spin carrying current carriers, and the at least two collector terminals are configured, each for receiving currents of the spin polarized spin carrying current carriers, the device being therefore configured and operable as a spin polarization splitter.

**32.** The device of claim 31 comprising a charge sensor arranged at said at least one collector terminal and configured for receiving a flux of the spin carrying current carriers having the predetermined spin polarization; the device being thereby configured and operable as a spin detector for detecting a spin polarization of the spin carriers.

**33.** The device of claim 15 comprising at least one injector terminal associated with the diffusive region, and at least one collector terminal associated with the ballistic region, the collector terminal being configured for receiving the spin polarized current of spin carriers, the device being therefore configured and operable as a spin filter for producing the current of spin carriers having the predetermined spin polarization.

**34.** The device of claim 15 configured and operable for spin dependent splitting of the input current emitted from the diffusive region into at least two spatially separated fluxes of the current carriers of differently directed spins propagating in the ballistic region.

**35.** The device of claim 34 comprising at least one injector terminal associated with the diffusive region, and at least two collector terminals associated with the ballistic region, each collector terminal being configured for receiving the spin polarized current of spin carriers, the device being therefore configured and operable as a spin filter for producing currents of differently directed spins.

**36.** The device of claim 1(i) wherein said structure is configured to create the region of inhomogeneity in the form of a lateral interface between two regions of the gas having different values of the spin-orbit coupling constant and/or different values of the density of the spin-carrying current carriers provided the spin-orbit coupling constant is of a non-zero value in at least one of these regions.

**37.** The device of claim 36 wherein said lateral interface has a curved geometry.

**38.** The device of claim 1(i) wherein said structure is configured to define the region of inhomogeneity of the gas having a lens-like geometry with a relatively reduced or relatively enhanced spin-orbit coupling constant and/or the density of the spin-carrying current carriers as compared to the gas surroundings of said lens-like region.

**39.** The device of claim 1(i) wherein the region of inhomogeneity is configured as a spin zone pattern so as to provide for focusing the input flux of the spin-carrying current carriers based on the spin dependent diffraction.

**40.** The device of claim 1(i) wherein said structure is configured to create the region of inhomogeneity in the form of an elongated stripe which has the relatively reduced or relatively enhanced spin-orbit coupling constant and/or the density of the spin-carrying current carriers as compared to the gas surroundings of said stripe.

**41.** The device of claim 40, wherein said desired orientation is such that at least one spin polarization component of the input flux of the spin-carrying current carriers undergoes total internal reflection while passing along the stripe.

**42.** The device of claim 40, wherein said desired orientation is such that the at least one polarization component of the input flux of the spin-carrying current carriers undergoes total internal reflection while passing through the stripe.

**43.** The device of claim 40 wherein said stripe has a curved geometry.

**44.** The device of claim 43 wherein said stripe has a closed loop shape.

**45.** The device of claim 1(i) wherein said at least one region of inhomogeneity of the gas is configured for redirecting the spin carrying current carriers, thereby to provide a spin focusing of the spin carrying current carriers.

**46.** The device of claim 1(i) wherein said at least one region of inhomogeneity of the gas is configured for guiding the spin polarized spin carrying current carriers along said region of inhomogeneity of the gas owing to the total internal reflection of the spin carrying current carriers to convey the spin current to a predetermined location in the device, to thereby provide a spin guide.

**47.** The device of claim 46 wherein said spin guide is configured in the shape of a closed loop having an entrance and at least one exit; to thereby provide a spin storage of the spin carrying current carriers.

**48.** The device of claim 1(i) further comprising a gate configured for altering a bias voltage being sufficient to affect said inhomogeneous two-dimensional gas of spin carrying current carriers, said bias voltage being applied to the gate for switching the deviation angles of at least a portion of the spin carrying current carriers between different predetermined ranges of angles; thereby to provide a spin switch device.

**49.** The device of claim 1(ii) configured and operable for splitting the input current indicative of an input signal emitted from the diffusive region into at least two spatially separated fluxes of the current carriers propagating in the ballistic region, thereby providing a signal splitter device.

**50.** A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, the structure being configured to provide a desired orientation between an input flux of unpolarized spin-carrying current carriers and said at least one region of inhomogeneity, the device being thereby configured and operable as a spin filter for producing a current of spin carriers having a predetermined spin polarization.

**51.** A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, the structure being configured to provide a desired orientation between an input flux of unpolarized spin-carrying current carriers and said at least one region of inhomogeneity, the device being therefore configured and operable as a spin polarization splitter.

**52.** A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, the structure being configured to provide a desired orientation between an input flux of spin-carrying current carriers and said at least one region of inhomogeneity, said at least one

region of inhomogeneity of the gas being configured for redirecting the spin carrying current carriers, thereby to provide a spin focusing of the spin carrying current carriers.

**53.** A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, the structure being configured to provide a desired orientation between an input flux of spin-carrying current carriers and said at least one region of inhomogeneity, said at least one region of inhomogeneity of the gas being configured for guiding the spin polarized spin carrying current carriers along said region of inhomogeneity of the gas owing to the total internal reflection of the spin carrying current carriers to convey the spin current to a predetermined location in the device, to thereby provide a spin guide.

**54.** A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, the structure being configured to provide a desired orientation between an input flux of spin-carrying current carriers and said at least one region of inhomogeneity, said at least one region of inhomogeneity of the gas being configured in the shape of a closed loop having an entrance and at least one exit for guiding the spin polarized spin carrying current carriers along said region of inhomogeneity owing to the total internal reflection of the spin carrying current carriers, to thereby provide a spin storage of the spin carrying current carriers.

**55.** A device for manipulating a direction of motion of current carriers, the device comprising a structure containing a two-dimensional gas of the current

carriers configured to define at least one region of inhomogeneity characterized by a substantially varying value of a spin-orbit coupling constant or characterized by a substantially varying value of density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, the structure being configured to provide a desired orientation between an input flux of spin-carrying current carriers and said at least one region of inhomogeneity, and comprising a gate configured for altering a bias voltage being sufficient to affect said inhomogeneous two-dimensional gas of spin carrying current carriers, said bias voltage being applied to the gate for switching deviation angles of at least a portion of the spin carrying current carriers between different predetermined ranges of angles; thereby to provide a spin switch device.

**56.** A device for manipulating a direction of motion of current carriers operable as signal splitter, the device comprising a structure containing a two-dimensional gas of current carriers configured to define a region of inhomogeneity in the form of a lateral interface between first and second regions differing from each other in at least the gas mobility such that the first region is diffusive and the second region is ballistic, thereby providing for emission of the current carriers indicative of the input signal from the diffusive region into the ballistic region with a wide angular range of directions of propagation of the current carriers in the ballistic region, thereby splitting the input signal into spatially separated components propagating with desired ranges of angles of propagation in the ballistic region.

**57.** A method of fabrication of a spintronic device for spin manipulation of a current of spin carrying current carriers, the method comprising: fabricating a structure containing a two-dimensional gas of spin carrying current carriers configured to define at least one region of inhomogeneity, which is characterized by a substantially varying magnitude of a spin-orbit coupling constant or is characterized by a substantially varying density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, and to define a desired orientation between an input flux of the spin carrying current carriers in the gas and said at least one region of inhomogeneity of the gas;

thereby enabling spin manipulations of said flux of the spin carrying current carriers to provide at least one of the following types of deviation of said spin carrying current carriers: spin dependent refraction, spin dependent reflection and spin dependent diffraction on desired deviation angles of a direction of motion of the spin carrying current carriers being incident on said at least one region of inhomogeneity of the gas.

**58.** The method of claim 57 wherein the inhomogeneous two-dimensional gas is provided by fabricating a laterally varying semiconductor structure by at least one technique selected from lithography, etching, deposition and implantation techniques.

**59.** The method of claim 57 wherein said structure is configured such that the inhomogeneous two-dimensional gas is confined by at least one nonuniform potential well.

**60.** The method of claim 59 wherein at least one portion of said at least one nonuniform potential well is an asymmetrical potential well.

**61.** The method of claim 59 wherein at least one part of the structure is fabricated from a uniaxial crystal compound with no inversion symmetry.

**62.** The method of claim 59 wherein the nonuniform potential well is created in a semiconductor structure.

**63.** The method of claim 62 wherein said structure is a semiconductor heterostructure.

**64.** The method of claim 63 wherein the semiconductor heterostructure is fabricated from compounds selected from group III – group V, and group II – group VI compounds.

**65.** The method of claim 64 wherein the semiconductor heterostructure is selected from $In_xGa_{1-x}As/In_yAl_{1-y}As$, $In_xGa_{1-x}As/InP$, InAs/AlSb, $In_xAl_{1-x}As/In_yGa_{1-y}As/ In_zAl_{1-z}As$, CdTe/HgTe/CdTe and $Hg_xCd_{1-x}Te$.

**66.** The method of claim 65 wherein x, y and z are in the range of about 0.1 to 1.

**67.** The method of claim 57 comprising providing an arrangement of barriers in said structure configured to define at least one injector terminal and at least one

collector terminal distant from each other, each terminal being defined by a space between the two nearest barriers, the terminals being arranged for allowing the carriers passage from the injector terminal to the collector terminal.

**68.** The method of claim 57 wherein the inhomogeneous two-dimensional gas is provided by arranging at least one gate configured for applying a bias voltage thereto, said bias voltage being sufficient to affect the two-dimensional gas of the spin carrying current carriers in a region near the gate, said bias voltage being sufficient to create said at least one region of inhomogeneity of the gas.

**69.** The method of claim 57, wherein said desired orientation is such that the current of the spin carrying current carriers contains the carriers that impinge onto said at least one region of inhomogeneity at a certain range of non-zero angles of incidence.

**70.** A method of fabrication of a spintronic device for spin manipulation of a current of spin carrying current carriers, the method comprising: providing a structure containing a two-dimensional gas of spin carrying current carriers; arranging at least one gate configured for allowing application of a bias voltage thereto sufficient to affect the two-dimensional gas of the spin carrying current carriers in a region near the gate to thereby enable creation of at least one region of inhomogeneity of the gas which is characterized by a substantially varying magnitude of a spin-orbit coupling constant or is characterized by a substantially varying density of the spin carrying current carriers provided the spin-orbit coupling constant is of non-zero value, and enable to define a desired orientation between an input flux of the spin carrying current carriers in the gas and said at least one region of inhomogeneity of the gas, to thereby provide at least one of the following types of deviation of the spin carrying current carriers: spin dependent refraction, spin dependent reflection and spin dependent diffraction on desired deviation angles of a direction of motion of the spin carrying current carriers being incident on said at least one region of inhomogeneity of the gas.

**71.** A method of fabrication of a device for manipulation of a direction of motion of current carriers operable as a signal splitter, the method comprising providing a structure containing a two-dimensional gas of current carriers and

configured to define at least one region of inhomogeneity in the form of a lateral interface between first and second regions of the structure differing from each other at least in a mobility of the gas such that the first region is diffusive and the second region is ballistic; thereby allowing for emitting the current carriers from the diffusive region into the ballistic region with a wide angular range of directions of propagation of the current carriers in the ballistic region.

**72.** The method of claim 71 wherein the region of inhomogeneity is defined by arranging at least one gate configured for applying a bias voltage thereto, said bias voltage being sufficient to affect the mobility of the gas in a region near the gate.

**73.** The method of claim 71 comprising fabricating in said structure an arrangement of barriers configured to define at least one injector terminal and at least one collector terminal distant from each other for allowing the carriers passage from the injector terminal to the collector terminal, each terminal being defined by a space between the two nearest barriers.

**74.** The method of claim 71 wherein said structure is a semiconductor heterostructure fabricated from compounds selected from Si, Ge, group IV – group IV, group III – group V, and group II – group VI compounds.

**75.** The method of claim 71 wherein said structure is configured such that the ballistic region differs from the diffusive region in the spin-orbit coupling constant, or differs in the density of the spin-carrying current carriers provided the spin-orbit coupling constant is of non-zero value in at least one of these regions.

**76.** The method of claim 75 comprising arranging in said structure at least one gate configured for applying a bias voltage thereto, said bias voltage being sufficient to affect the two-dimensional gas of the current carriers in a region near the gate to thereby create the difference between said regions in at least one parameter selected from the spin-orbit coupling constant, density, and mobility.

**77.** The method of claim 75 wherein said structure is configured such that the inhomogeneous two-dimensional gas is confined by at least one nonuniform potential well.

**78.** The method of claim 77 wherein at least one portion of said at least one nonuniform potential well is an asymmetrical potential well.

**79.** The method of claim 77 wherein at least one part of said structure is fabricated from a uniaxial crystal compound with no inversion symmetry.

**80.** The method of claim 77 wherein said structure is a semiconductor heterostructure.

**81.** The method of claim 80 wherein the semiconductor heterostructure is fabricated from compounds selected from group III – group V and group II – group VI compounds.

**82.** The method of claim 81 wherein the semiconductor heterostructure is selected from $In_xGa_{1-x}As/In_yAl_{1-y}As$, $In_xGa_{1-x}As/InP$, InAs/AlSb, $In_xAl_{1-x}As/In_yGa_{1-y}As/In_zAl_{1-z}As$, CdTe/HgTe/CdTe and $Hg_xCd_{1-x}Te$.

**83.** The method of claim 82 wherein x, y and z are in the range of about 0.1 to 1.

**84.** A method for spin manipulation of a current of spin carrying current carriers, the method comprising: providing an input flux of the spin carrying current carriers in a two-dimensional gas of the spin carriers configured to define at least one region of inhomogeneity which is characterized by a substantially varying spin-orbit coupling constant or characterized by a substantially varying density of the carriers provided the spin-orbit coupling constant is of non-zero value; and providing a desired orientation between the input flux of the carriers and said at least one region of inhomogeneity; the method thereby providing at least one of the following types of deviation of the carriers: spin dependent refraction, spin dependent reflection and spin dependent diffraction on desired deviation angles of a direction of motion of the carriers being incident on said at least one region of inhomogeneity of the gas.

**85.** The method of claim 84 wherein said desired orientation is such that the flux of the carriers contains the carriers that impinge onto said at least one region of inhomogeneity at certain non-zero angles of incidence.

**86.** The method of claim 84 wherein said spin manipulation of the flux of the carriers includes a spin polarizing of the flux; thereby providing a flux of spin polarized carriers.

**87.** The method of claim 86 wherein said spin manipulation of the flux of the carriers includes receiving the spin carrying current carriers by at least one collector arranged for collecting the current carriers of a predetermined spin polarization, thereby providing for spin filtering or spin splitting the input flux of the spin carrying current carriers.

**88.** The method of claim 84 wherein said at least one region of inhomogeneity of the gas is configured for redirecting the carriers, thereby to provide a spin focusing the carriers.

**89.** The method of claim 84 wherein said spin manipulation of the current of the spin carriers includes a spin guiding of the spin current of spin polarized spin carriers along said at least one area of inhomogeneity of the gas owing to the total internal reflection of the spin carriers; thereby conveying the spin current to a predetermined place in the two-dimensional gas of spin carriers.

**90.** The method of claim 84 further comprising changing a magnitude of at least one parameter selected from a spin-orbit coupling constant, density of the spin carriers and the incident angles at which said spin carriers are incident on the area of inhomogeneity of the gas.

**91.** The method of claim 90 wherein said spin manipulation of the current of the spin carrying current carriers includes a controllable switching of the deviation angles of the direction of motion of the spin carrying current carriers between different predetermined ranges of angles.

**92.** The method of claim 91 wherein said changing of the magnitude of said at least one parameter selected from the spin-orbit coupling constant, density of the spin carriers, and the incident angles at which said spin carrying current carriers are incident on the area of inhomogeneity of the gas includes applying a bias voltage to a gate, said bias voltage being sufficient to affect said two-dimensional gas of the spin carrying current carriers.

**93.** The method of claim 92 wherein a magnitude of said desired deviation angles depends on the magnitude of said bias voltage.

**94.** The method of claim 84 wherein said desired deviation angles of the direction of motion of the spin carriers are different for the spin carrying current carriers with different spin polarizations.

**95.** The method of claim 84 wherein the varying of the spin-orbit coupling constant of the gas within said at least one area of inhomogeneity of the gas measured in units of Fermi velocity is larger than about 0.001.

**96.** The method of claim 84 wherein said spin carriers are selected from electrons and holes.

**97.** A method for manipulation of a direction of motion of current carriers to provide for signal splitting, the method comprising: operating a structure, containing a two-dimensional gas of said carriers and configured to define a region of inhomogeneity in the for of a lateral interface between first and second adjacent regions one being diffusive and the other being ballistic, allowing for emitting the current carriers from the diffusive region into the ballistic region with a wide angular range of directions of propagation of the current carriers in the ballistic region; and collecting the current carriers propagating in the ballistic region within one or more desired range of angles of propagation.